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MANURIAL TRIALS WITH SOUR GRASS

(*Andropogon pertusus*).

By

S. J. SAINT,. M Sc., Ph.D., F.I.C.

Manurial trials with sugar cane have shown that, under Barbados conditions, water is almost always the principal factor limiting yield. Field experiment showed that effective mulching during the dry season resulted in increased yields of between four and six tons of cane per acre. The beneficial effect of mulching is generally realised, but the main difficulty, with regard to a more general use of the practice on the plantations was, and is, a lack of suitable material. The only supply of organic matter on the plantations, which could be appreciably increased, and hence serve as a further source of mulching material, appeared to be from the sour grass meadows. These meadows are generally to be found on land which is too shallow to grow cane, and often coral rock is seen protruding through the soil in these fields.

Sour grass (*Andropogon pertusus*) is, like the sugar cane, a plant which is able to withstand the normal dry season which is experienced in Barbados between January and June, and which is subsequently able to make rapid growth when the rainy season commences. The grass is used very largely for the feeding of stock and as litter in the pens, and although the composition indicates that it is relatively poor in nutritive value, it is largely grown in Barbados because it appears able to give reasonable yields under the poor soil conditions and the prevailing climatic conditions. Sour grass has been grown on these meadows for a very long time, and, although one, and sometimes two or more crops of grass are cut and carted each year, there has been no general practice of returning nutrients to replace those removed in the grass. It seemed probable, therefore, that applications of manure would result in increased yields of grass, and hence prove one way of increasing the supply of mulching material for the sugar cane lands.

Preliminary trials showed that the application of a quick acting nitrogenous manure changed the colour of the grass and resulted in better growth, indicating that nitrogen was the principal need of these sour grass meadows. Owing to the poor nature of most sour grass meadows, it was thought advisable to lay down plots which could be treated similarly each year, and so investigate the cumulative effects of nitrogen alone, nitrogen plus phosphate, nitrogen plus potash and nitrogen plus phosphate and potash. In addition, since vacuum pan molasses—a bye-product of the sugar factories—in most years cannot be entirely disposed of profitably, it was decided to investigate the value of this material as a manure for sour grass.

It is probable that dressings of farm yard manure to these sour grass meadows would be of considerable value, but enquiries of planters showed that any farm yard manure made on the plantation would be applied to sugar cane land. It was, therefore, considered of little value to include farm yard manure in these trials, since, whatever the results, it was considered most unlikely that planters could be persuaded to apply this material to their grass land.

CENTRES.

Two centres were selected for these trials: (a) a red soil centre (Todds) with, on the average, a high rainfall, and (b) a black soil centre (Graeme Hall) with, on the average, a low rainfall. At both centres, the selected fields were typical shallow soil sour grass meadows with the coral limestone rock very near the surface.

PLAN.

The lay-out was in the form of a 6 x 6 Latin Square. The size of each plot was 10 yards by 10 yards, and the whole of the grass was cut and weighed. A representative sample of grass from each treatment was brought to the laboratory and an ordinary feeding stuff analysis was made as well as an analysis of the ash.

APPLICATION OF MANURE.

The grass was cut after the dry season in June, and the manures were then applied. The second cutting was made in December, after the rainy season. Table I shows the amount and nature of the manures which have been applied to the plots each year since 1932.

TABLE I.

Plot.	Manures applied per acre.	Nutrients (lb. per acre).		
		N.	P_2O_5	K_2O
1	Unmanured	....	....	....
2	2 cwt. Sulphate of Ammonia	45	....	....
3	2 cwt. Sulphate of Ammonia and 1 cwt. Superphosphate	45	18	....
4	2 cwt. Sulphate of Ammonia and 1 cwt. Muriate of Potash	45	....	67
5	2 cwt. Sulphate of Ammonia, 1 cwt. Superphosphate and 1 cwt. Muriate of Potash	45	18	67
6	2 tons Vacuum Pan Molasses	34	6	63

YIELD RESULTS.

The mean yields of grass from the various plots are shown in Table II, for the black soil centre, and in Table III for the red soil centre.

TABLE II..
Graeme Hall.

Year,	Date of Cutting.	Yields of Grass (lb. per acre.)					
		O.	N.	N. + P.	N. + K.	N + P + K	V. P. M.
1932-33	Dec.	8,372	10,698	10,698	15,442	18,345	8,566
	June	1,825	2,057	2,057	2,265	2,638	1,960
1933-34	Dec.	7,356	8,832	9,074	11,254	13,269	7,694
	June	2,904	3,112	3,049	3,500	3,737	3,011
1934-35	Dec.	5,507	5,120	4,608	6,858	8,286	6,302
	June	3,911	3,437	2,954	4,439	4,960	4,390
1935-*36	Dec.	7,560	8,164	6,848	11,652	14,352	7,850
	June						
1936	Dec.	15,082	16,744	14,270	18,598	21,530	12,925
Mean 1932-36	Dec.	8,775	9,911	9,099	12,760	15,156	8,667
Mean 1932-35	June	2,880	2,868	2,686	3,401	3,778	3,120

TABLE III.
Todds.

Year.	Date of Cutting.	Yields of Grass (lb. per acre.)					
		O.	N.	N. + P.	N. + K.	N + P + K	V. P. M.
1932-33	Dec.	9,244	13,844	15,588	17,860	20,040	9,583
	June	4,148	4,778	4,637	4,429	4,865	4,163
1933-34	Dec.	7,744	14,330	14,038	13,458	16,942	9,002
	June	4,533	5,227	4,951	4,893	5,334	4,734
1934-35	Dec.	8,630	11,632	11,560	13,128	14,555	10,224
	June	4,172	5,120	5,120	5,251	5,484	4,840
1935-36	Dec.	7,342	11,846	11,658	14,294	16,652	9,486
	June	2,314	2,459	2,169	3,195	3,548	3,277
1936	Dec.	16,758	18,210	16,058	24,310	27,615	19,152
Mean 1932-36	Dec.	9,943	13,972	13,780	16,610	19,160	11,489
Mean 1932-36	June	3,791	4,396	4,219	4,442	4,807	4,253

* A fire during the 1936 crop season caused the grass on these plots to be burnt so that no weights are available for the June cutting, 1936.

THE UNMANURED PLOTS.

The yields of grass from the unmanured plots may be taken as approximating to the yields of sour grass from most unmanured meadows in Barbados. The yields vary somewhat from year to year with the climatic conditions. In Tables IV and V, the yields from the unmanured plots are shown together with the rainfall for that growth period. It will be noted that an unusually high yield of grass was obtained after the rainy season of 1936, which cannot be entirely explained by the rainfall. The dry season of 1936 was exceptionally dry, and it would appear that this may be partly the reason for the greater quantity of grass which was reaped at the end of the subsequent wet season.

TABLE IV.

UNMANURED PLOTS.

Graeme Hall.

Time of Cutting.	Dec. 1932	June 1933	Dec. 1933	June 1934	Dec. 1934	June 1935	Dec. 1935	June 1936	Dec. 1936
Yield (lb. per acre)	8,372	1,825	7,356	2,904	5,507	3,911	7,560	...	15,082
Rainfall (Inches.)	33	7½	36	5½	18	7½	36½	5½	45½

TABLE V.

UNMANURED PLOTS.

Todds.

Time of Cutting.	Dec. 1932	June 1933	Dec. 1933	June 1934	Dec. 1934	June 1935	Dec. 1935	June 1936	Dec. 1936
Yield (lb. per acre.)	9,244	4,148	7,744	4,533	8,630	4,172	7,342	2,314	16,758
Rainfall (Inches.)	53½	15	53	10	29	18½	52½	7½	45

The sour grass as cut has a much higher dry matter content than that of average green fodders, so that the weights given represent a greater yield of dry matter per acre than would normally be expected. Average analyses of sour grass, as cut at the end of the wet season in December, and at the end of the dry season in June, are given in Table VI.

TABLE VI.

ANALYSES OF SOUR GRASS.

Time of Cutting	Moisture	Crude Protein	Crude Fat	Carbo-hydrates	Crude Fibre	Ash.
December ..	52.8	1.8	1.3	23.6	16.5	4.0
June	28.1	1.7	2.0	36.6	23.8	7.8

The composition of sour grass and the nutritive value was discussed in the Report of the Department of Agriculture 1929—30, pp. 99—102.

THE NITROGEN PLOTS.

The average unmanured sour grass meadows in Barbados have a yellowish-green colour in the wet season, and, when the general landscape is viewed from a distance, such fields stand out distinctly against the dark green foliage of the cane fields. This yellowish-green colour is due to a lack of available nitrogen in the soil, since an application of some quick acting nitrogenous manure rapidly changes the colour of the leaves to a dark green. In addition the yield of grass is increased.

The effect of annual additions of two hundredweight of sulphate of ammonia per acre on the yield of grass as compared with the unmanured plots is shown in Tables VII and VIII.

TABLE VII.

EFFECT OF NITROGEN AS SULPHATE OF AMMONIA.

Graeme Hall.

YIELDS PER ACRE—LB. (MEANS OF 6).

Time of Cutting.	Dec. 1932	June 1933	Dec. 1933	June 1934	Dec. 1934	June 1935	Dec. 1935	June 1936	Dec. 1936
Nitrogen	10,698	2,057	8,832	3,112	5,120	3,437	8,164	...	16,744
Unmanured ...	8,372	1,825	7,356	2,904	5,507	3,911	7,560	...	15,082
Difference	2,326	232	1,476	208	—387	—526	604	...	1,662
Significant Difference ...	1,520	281	426	416	687	658	1,239	...	2,981

TABLE VIII.

EFFECT OF NITROGEN AS SULPHATE OF AMMONIA.

Todds.

YIELDS PER ACRE—LB. (MEANS OF 6.)

Time of Cutting.	Dec. 1932	June 1933	Dec. 1933	June 1934	Dec. 1934	June 1935	Dec. 1935	June 1936	Dec. 1936
Nitrogen ...	13.844	4.778	14.330	5.227	11.632	5.120	11.846	2.793	18.210
Unmanured	9.244	4.148	7.744	4.533	8.680	4.172	7.342	2.314	16.758
Difference ...	4.600	630	6.586	694	3.002	948	4.504	479	1.452
Significant Difference .	2.923	571	1.355	426	1.176	600	1.665	760	3.281

Statistical Analysis :

Differences between the mean yields which have a 20:1 chance of being due to treatments are shown at the base of the tables.

There have been larger responses to the nitrogenous manuring at the higher rainfall station, but there is some indication that, at both stations, the response to the annual dressing of sulphate of ammonia is becoming less. The second cutting of grass in June shows that the nitrogen applied in the previous June gives further increases in yield, indicating that the whole of the nitrogen applied is not removed by the first cutting of grass.

In the field, the grass growing on the continuously manured nitrogen plots does not look healthy. The grass becomes badly spotted and appears infected with some rust disease. The grass on the adjoining no-manure plots remains yellowish green in colour, and the leaves are quite free from rust spots. The time of flowering on these nitrogen plots is usually about midway between the time of flowering of the grass on the phosphate plots and on those receiving potash.

THE NITROGEN AND PHOSPHATE PLOTS.

The sour grass on the plots which are manured annually with sulphate of ammonia and superphosphate matures and flowers very much earlier than the grass on the other plots. The grass appears most unhealthy; the leaves become affected with rust spots and the tips of the leaves become brown, and the whole plant dries up quite early. The result is that the plots have a brown, dry appearance when the other plots are still green and at this time the phosphate plots are very noticeable when the experiment, as a whole, is viewed from a distance.

The mean yields of grass from the nitrogen and phosphate plots, and the differences from the yield of the no-manure plots are shown in Tables IX and X.

It will be noted that, at the low rainfall centre, the yield of these plots has been less than that of the no-manure plots for the past three years, although only in 1935 can the difference be regarded as significant. At the red soil centre, the yield of the nitrogen and phosphate plots has steadily deteriorated when compared with the no-manure plots.

It can be seen that the addition of phosphates to sulphate of ammonia has had no beneficial effect on the yield of grass; in fact, the indications are that the addition of phosphate depresses the yield obtained with nitrogen alone. In Tables XI and XII the yields of the nitrogen plus phosphate plots are compared with the yield of the nitrogen plots, and it will be noted that, at both centres, the yields of grass from the nitrogen plus phosphate plots are each year becoming smaller than those from the plots receiving nitrogen alone.

TABLE IX.

EFFECT OF SULPHATE OF AMMONIA AND SUPERPHOSPHATE.

Graeme Hall.

YIELDS PER ACRE — LB. (MEANS OF 6).

Time of Cutting	Dec. 1932	June 1933	Dec. 1933	June 1934	Dec. 1934	June 1935	Dec. 1935	June 1936	Dec. 1936
Nitrogen + Phosphate	10,698	2057	9074	3049	4608	2953	6848	—	14,270
Unmanured	18,372	1825	7356	2904	5507	3911	7560	—	15,082
Difference	2326	232	1718	145	—899	—958	—712	—	—812
Significant Difference	1520	281	426	416	687	687	1239	—	2981

TABLE X.

EFFECT OF SULPHATE OF AMMONIA AND SUPERPHOSPHATE.

Todds.

YIELDS PER ACRE—LB. (MEANS OF 6).

Time of Cutting	Dec. 1932	June 1933	Dec. 1933	June 1934	Dec. 1934	June 1935	Dec. 1935	June 1936	Dec. 1936
Nitrogen and Phosphate	15,588	4,637	14,038	4,951	11,560	5,120	11,658	2,169	16,058
Unmanured	9,244	4,148	7,744	4,533	8,630	4,172	7,342	2,314	16,758
Difference	6,344	489	6,294	418	2,930	948	4,316	—145	—700
Significant Difference	2,923	571	1,355	426	1,176	600	1,665	760	3,281

Statistical Analysis:

Differences between the mean yields which have a 20:1 chance of being due to treatments are shown at the base of the tables.

TABLE XI.

EFFECT OF SUPERPHOSPHATE WHEN APPLIED WITH SULPHATE OF AMMONIA.

Graeme Hall.

YIELDS PER ACRE — LB. (MEANS OF 6).

Time of Cutting	Dec. 1932	June 1933	Dec. 1933	June 1934	Dec. 1934	June 1935	Dec. 1935	June 1936	Dec. 1936
Nitrogen and Phosphate	10,698	2,057	9,074	3,049	4,608	2,953	6,848	——	14,270
Nitrogen alone	10,698	2,057	8,832	3,112	5,120	3,437	8,164	——	16,744
Difference	0	0	242	—63	—512	—484	—1,316	——	—2,474
Significant Difference ...	1,520	281	426	416	687	658	1,239	——	2,981

TABLE XII.

EFFECT OF SUPERPHOSPHATE WHEN APPLIED WITH SULPHATE OF AMMONIA.

Todds.

YIELDS PER ACRE—LB. (MEANS OF 6).

Time of Cutting	Dec. 1932	June 1933	Dec. 1933	June 1934	Dec. 1934	June 1935	Dec. 1935	June 1936	Dec. 1936
Nitrogen and Phosphate	15,588	4,637	14,038	4,951	11,560	5,120	11,658	2,169	16,058
Nitrogen alone	13,844	4,778	14,330	5,227	11,632	5,120	11,846	2,459	18,210
Difference	1,744	—141	—292	—276	—72	0	—188	—290	—2,152
Significant Difference	2,923	571	1,355	426	1,176	600	1,665	760	3,281

Statistical Analysis :

Differences between the mean yields which have a 20:1 chance of being due to treatments are shown at the base of the tables.

THE NITROGEN AND POTASH PLOTS.

The plots manured with sulphate of ammonia and muriate of potash show quite clearly that the rust diseases associated with the nitrogen and the nitrogen plus phosphate plots, is due largely, if not entirely, to a deficiency of potash. The grass growing on the nitrogen plus potash plots is quite free from the rust disease, and continues green and healthy after the grass on the potash deficient plots has turned brown. Flowering is also delayed although flowering spikes appear before those on the unmanured plots.

The yields of grass from the nitrogen and potash plots and the differences from the yields of the unmanured plots are shown in Tables XIII and XIV.

TABLE XIII.

EFFECT OF SULPHATE OF AMMONIA AND MURIATE OF POTASH.

Graeme Hall.

YIELDS PER ACRE—LB. (MEANS OF 6).

Time of Cutting	Dec. 1932	June 1933	Dec. 1933	June 1934	Dec. 1934	June 1935	Dec. 1935	June 1936	Dec. 1936
Nitrogen and Potash	15,442	2265	11,254	3500	6858	4439	11,652	—	18,598
Unmanured	8372	1825	7356	2904	5507	3911	7560	—	15,082
Difference	7070	440	3898	596	1351	528	4092	—	3516
Significant Difference	1520	281	426	416	687	658	1239	—	2981

TABLE XIV.

EFFECT OF SULPHATE OF AMMONIA AND MURIATE OF POTASH.

Todds.

YIELDS PER ACRE—LB. (MEANS OF 6).

Time of Cutting	Dec. 1932	June 1933	Dec. 1933	June 1934	Dec. 1934	June 1935	Dec. 1935	June 1936	Dec. 1936
Nitrogen and Potash	17,860	4429	13,458	4893	13,128	5251	14,294	3195	24,310
Unmanured	9244	4148	7744	4533	8630	4172	7342	2314	16,758
Difference	8616	281	5714	360	4498	1079	6952	881	7552
Significant Difference	2923	571	1355	426	1176	600	1665	760	3281

Statistical Analysis :

Differences between the mean yields which have a 20:1 chance of being due to treatments are shown at the base of the tables.

A consideration of the yield results shows the marked effect which the addition of potash to the nitrogenous manuring has had on the yield of grass. It is evident that these sour grass meadows rapidly reach a state where potash becomes a limiting factor if growth is stimulated with applications of sulphate of ammonia.

THE NITROGEN, PHOSPHATE AND POTASH PLOTS :

When the plots are inspected, those manured with nitrogen, phosphate and potash quite obviously bear the heaviest yield of grass. The grass appears healthy and green, and is free of the rust disease which so markedly affects the nitrogen and nitrogen plus phosphate plots. Flowering occurs at about the same time as on the nitrogen plus potash plots.

The yields of grass from the nitrogen, phosphate and potash plots, and the differences from the yields of the unmanured plots are shown in Tables XV and XVI.

TABLE XV.

EFFECT OF SULPHATE OF AMMONIA, SUPERPHOSPHATE AND MURIATE OF POTASH.

Graeme Hall.

YIELDS PER ACRE — LB. (MEANS OF 6).

Time of Cutting	Dec. 1932	June 1933	Dec. 1933	June 1934	Dec. 1934	June 1935	Dec. 1935	June 1936	Dec. 1936
Nitrogen+ Phosphate+ Potash	18,345	2,638	13,269	3,737	8,286	4,960	14,352	——	21,530
Unmanured	8,372	1,825	7,356	2,904	5,507	3,911	7,560	——	15,082
Difference	9,973	813	5,913	833	2,779	1,049	6,792	——	6,448
Significant Difference	1,520	281	426	416	687	658	1,239	——	2,981

TABLE XVI.

EFFECT OF SULPHATE OF AMMONIA, SUPERPHOSPHATE AND MURIATE OF POTASH.

Todds.

YIELDS PER ACRE—LB. (MEANS OF 6).

Time of Cutting.	Dec. 1932	June. 1933	Dec. 1933	June 1934	Dec. 1934	June 1935	Dec. 1935	June. 1936	Dec. 1936
Nitrogen + Phosphate + Potash	20,040	4,865	16,942	5,334	14,355	5,484	16,652	3,548	27,615
Unmanured	9,244	4,148	7,744	4,533	8,630	4,172	7,342	2,314	16,758
Difference	10,796	717	9,198	801	5,925	1,312	9,310	1,234	10,857
Significant Difference	2,923	571	1,355	426	1,176	600	1,665	760	3,281

Statistical Analysis:

Differences between the mean yields which have a 20:1 chance of being due to treatments are shown at the base of the tables.

The yield results given in these Tables show that the weight of grass may be increased from 1½—5 tons per acre as a result of an application of the complete dressing of artificials used in these experiments.

THE VACUUM PAN MOLASSES PLOTS.

These plots were dressed with Vacuum Pan Molasses at the rate of two tons per acre. This application contained nearly the same amount of potash, three quarters the amount of nitrogen and one third the amount of phosphate as the complete dressing of artificials.

The nitrogen in the molasses had no visual effect on the grass. The colour of the molasses plots remained the same yellowish green as the unmanured plots. There was no rapid darkening in the colour of the grass as occurred on the plots receiving sulphate of ammonia. The grass appeared healthy and no rust disease developed.

The yields of grass from the molasses plots and the differences from the yields of the unmanured plots are shown in Tables XVII and XVIII.

TABLE XVII.

EFFECT OF VACUUM PAN MOLASSES.

Graeme Hall.

YIELDS PER ACRE—LB. (MEANS OF 6).

Time of Cutting.	Dec. 1932	June. 1933	Dec. 1933	June. 1934	Dec. 1934	June. 1935	Dec. 1935	June. 1936	Dec. 1936
Molasses	8,566	1,960	7,694	3,011	6,302	4,390	7,850	....	12,925
Unmanured	8,372	1,825	7,356	2,904	5,507	3,911	7,560	....	15,082
Difference	194	135	338	107	795	479	290	....	2,157
Significant Difference	1,520	281	426	416	687	658	1,239	....	2,981

TABLE XVIII.

EFFECT OF VACUUM PAN MOLASSES.

Todds.

YIELDS PER ACRE—LB. (MEANS OF 6).

Time of Cutting.	Dec. 1932	June. 1933	Dec. 1933	June. 1934	Dec. 1934	June. 1935	Dec. 1935	June. 1936	Dec. 1936
Molasses	9,583	4,163	9,002	4,734	10,224	4,840	9,486	3,277	19,152
Unmanured	9,244	4,148	7,744	4,533	8,630	4,172	7,342	2,314	16,758
Difference	339	15	1,258	201	1,594	668	2,144	963	2,394
Significant Difference	2,923	571	1,355	426	1,176	600	1,665	760	3,281

Statistical Analysis :

Differences between the mean yields which have a 20:1 chance of being due to treatments are shown at the base of the tables.

It will be noted from these yield results that the annual application of two tons of vacuum pan molasses has had little effect in increasing the yield of grass. There is a slight increase, but, except for the year 1934, this increase can scarcely be considered significant.

The yields of grass have been calculated for each year on the basis of the no-manure plot being equivalent to 100. These yields have been plotted in Figs. I and II, where the comparative effects of the different manures may be seen for each year.

EFFECT OF MANURING ON COMPOSITION OF SOUR GRASS.

NITROGEN.

The results of the total nitrogen determinations, which have been made on the samples of grass from the differently manured plots, are shown in Table XIX. It is evident from these figures that the protein content of the dry matter of the grass is not altered significantly by manuring. This was the conclusion reached in earlier experiments. (Report of Department of Agriculture, Barbados, 1929—30, p. 99.)

TABLE XIX.

PER CENT. NITROGEN IN DRY MATTER OF SOUR GRASS FROM MANURIAL TRIAL PLOTS.

Graeme Hall.

Manurial Treatment	TIME OF REAPING.					
	December, 1932		June, 1935		December, 1935	
	Per Cent. N in Dry Matter	Diff. from no Manure	Per Cent. N in Dry Matter	Diff. from no Manure	Per Cent. N in Dry Matter	Diff. from no Manure
No Manure	0.46	——	0.51	——	0.32	——
Nitrogen ..	0.67	+0.21	0.63	+0.12	0.42	+0.10
Nitrogen + Phosphate	0.54	+0.08	0.82	+0.31	0.48	+0.16
Nitrogen + Potash ..	0.43	—0.03	0.53	+0.02	0.28	—0.04
Nitrogen + Phosphate + Potash ..	0.54	+0.08	0.47	—0.04	0.35	+0.03
Vacuum Pan Molasses ..	0.45	—0.01	0.47	—0.04	0.29	—0.03

Manurial Treatment	TIME OF REAPING. December, 1932		June, 1935		December, 1935	
	Per Cent. N in Dry Matter	Diff. from no Manure	Per Cent. N in Dry Matter	Diff. from no Manure	Per Cent. N in Dry Matter	Diff. from no Manure
No Manure	0.55	——	0.47	——	0.42	——
Nitrogen ..	0.51	—0.04	0.47	0	0.42	0
Nitrogen + Phosphate ..	0.51	—0.04	0.63	+0.16	0.45	+0.03
Nitrogen + Potash ..	0.38	—0.17	0.42	—0.05	0.37	—0.05
Nitrogen + Phosphate + Potash ..	0.38	—0.17	0.47	0	0.39	—0.03
Vacuum Pan Molasses ..	0.47	—0.08	0.54	+0.07	0.37	—0.05

Potash :-

Potash was determined in the ash of the sour grass samples, and, from a consideration of the figures obtained, it is at once apparent that the potash manuring has increased the potash content of the grass. This is especially evident at the black soil centre. At Graeme Hall, the potash in the grass from the nitrogen and nitrogen plus phosphate plots is also higher than that from the unmanured plots, but the increase is less marked than it is on the plots receiving potash. At both centres, the grass from the plots receiving vacuum pan molasses has a much higher potash content than the grass from the unmanured plots. It is therefore evident that the grass is obtaining potash from the molasses manuring; the fact that the yield of grass from the molasses plots is so poor must be due to a lack of quickly available nitrogen.

The actual figures obtained are given in Table XX.

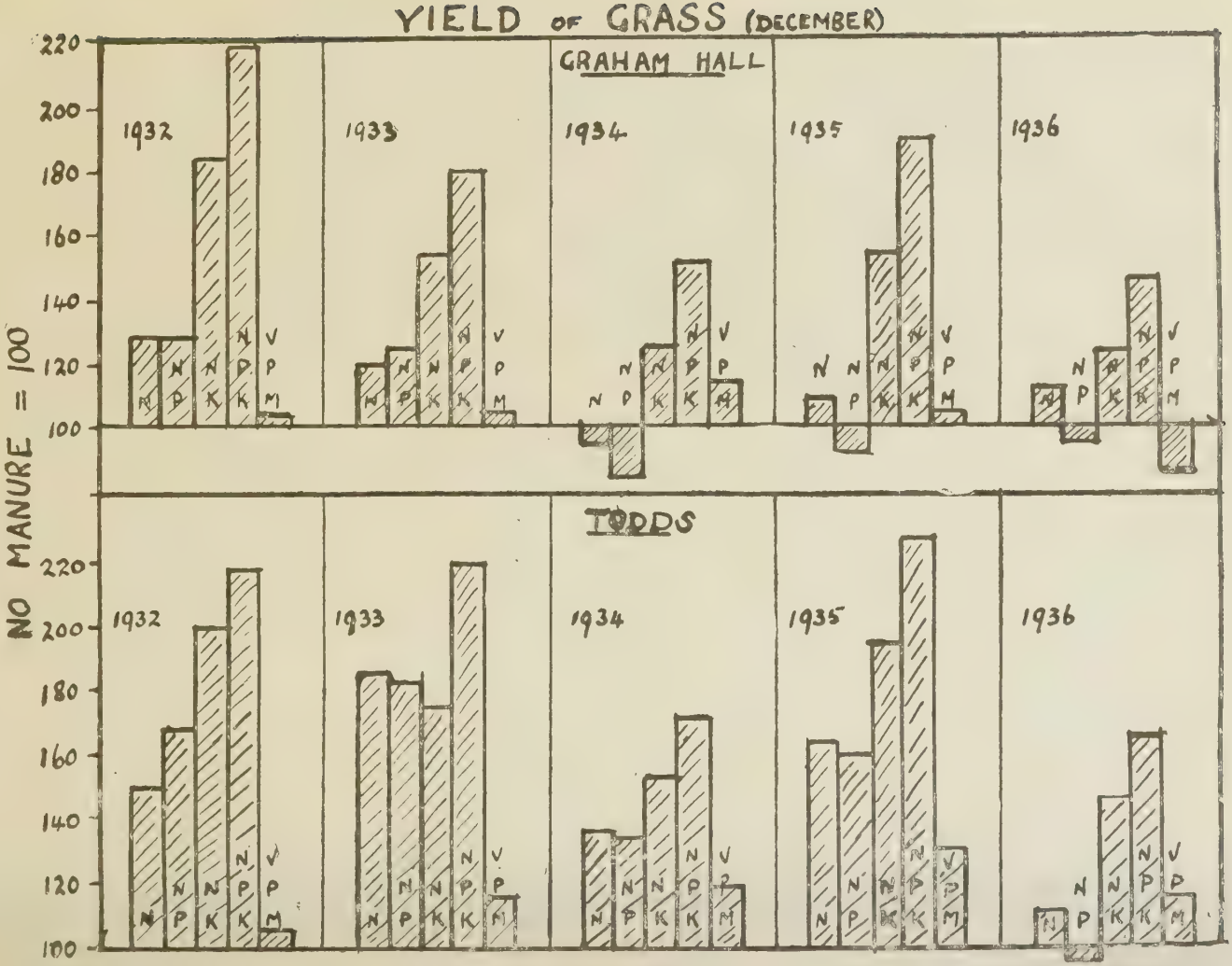

YIELD OF GRASS (DECEMBER)
GRAHAM HALL
TODDS
NO MANURE = 100
220
200
180
160
140
120
100
1932
1933
1934
1935
1936
N
NP
NK
NPK
V
P
M

TABLE XX.

PERCENTAGE POTASH IN THE ASH OF SOUR GRASS FROM DIFFERENTLY MANURED PLOTS.

Graeme Hall.

Treatment	Dec. 1932 Per Cent K_2O in Ash	Dec. 1932 Diff from no Manure Plot	Dec. 1933 Per Cent K_2O in Ash	Dec. 1933 Diff. from no Manure Plot	June 1935 Per Cent. K_2O in Ash	June 1935 Diff from no Manure Plot	Dec. 1935 Per Cent. K_2O in Ash	Dec. 1935 Diff. from no Manure Plot	Mean Difference
O	1.73	—	1.44	—	1.13	—	2.56	—	—
N	2.33	+0.60	3.07	+1.63	2.20	+1.07	4.53	+1.97	+1.32
N + P	2.00	+0.27	2.74	+1.30	2.09	+0.96	3.23	+0.67	+0.88
N + K	3.08	+1.35	3.88	+2.44	1.95	+1.82	5.67	+3.11	+2.18
N+P+K	4.56	+2.83	4.76	+3.32	2.99	+1.86	6.75	+4.19	+3.05
VPM	5.18	+3.45	4.43	+3.00	2.49	+1.36	4.71	+2.15	+2.99
				Todds.					
O	1.89	—	1.51	—	1.04	—	2.80	—	—
N	1.58	—0.31	1.43	—0.08	1.04	0.00	1.75	—1.05	—0.36
N + P	1.18	—0.71	1.57	+0.06	1.35	+0.31	1.59	—1.21	—0.39
N + K	2.15	+0.26	2.16	+0.55	1.55	+0.51	4.76	+1.96	+0.82
N+P+K	1.82	—0.07	2.40	+0.89	1.74	+0.70	3.48	+0.68	+0.55
VPM	1.47	—0.42	2.77	+1.26	1.60	+0.56	3.65	+0.85	+0.56

PHOSPHATES.

The phosphates in the ash of the sour grass samples from the differently manured plots are also related to the types of manures used.

As with the potash results, differences are more marked at Graeme Hall than at Todds. As would be expected, the grass from the plots receiving phosphate show the greatest increases of phosphate in the ash over the unmanured plots. The grass from the nitrogen plus potash plots at both centres shows a smaller phosphate content in the ash than the grass from the unmanured plots. At both centres, the grass from the nitrogen plots shows an increased percentage of phosphate in the ash over the grass from the unmanured plots, but the increase is small at the red soil centre. The average phosphate in the ash of the grass from the plots receiving vacuum pan molasses is slightly less at Graeme Hall and slightly more at Todds than from the unmanured plots and these differences are probably not significant.

The results are given in Table XXI.

TABLE XXI.

PERCENTAGE PHOSPHORIC ACID IN THE ASH OF SOUR GRASS FROM DIFFERENTLY MANURED PLOTS.

Graeme Hall.

Treatment.	December, 1932.		December, 1933.		December, 1935.		December, 1936.		Mean Difference.
	Per Cent. P_2O_5 in Ash.	Diff. from no Manure Plot.	Per Cent. P_2O_5 in Ash.	Diff. from no Manure Plot.	Per Cent. P_2O_5 in Ash.	Diff. from no Manure Plot.	Per Cent. P_2O_5 in Ash.	Diff. from no Manure Plot.	
O	1.63	....	2.39	....	2.31	....	1.93	....	....
N	3.15	+1.52	2.60	+0.21	4.21	+1.90	1.98	+0.05	+0.92
N + P	2.13	+0.50	2.90	+0.51	4.39	+2.08	3.49	+1.56	+1.16
N + K	1.54	—0.09	1.94	—0.45	2.34	+0.03	1.12	—0.81	—0.33
N + P + K	3.12	+1.49	2.95	+0.56	5.18	+2.87	3.10	+1.07	+1.50
V. P. M.	2.05	+0.42	2.06	—0.33	1.87	—0.44	1.58	—0.35	—0.17
Todds.									
O	1.81	....	2.60	....	2.15	....	1.70	....	....
N	1.98	+0.17	1.92	—0.68	2.70	+0.55	2.34	+0.64	+0.17
N + P	1.85	+0.04	2.92	+0.32	3.02	+0.87	2.03	+0.33	+0.39
N + K	1.54	—0.27	1.83	—0.77	1.96	—0.19	1.84	+0.14	—0.27
N + P + K	1.56	—0.25	2.42	—0.18	2.91	+0.76	3.75	+2.05	+0.60
V. P. M. ...	2.07	+0.26	2.26	—0.34	2.32	+0.17	2.45	+0.75	+0.21

ANALYSIS OF SOIL SAMPLES FROM THE PLOTS.

Before the application of the manures in June, 1936, the soil on each plot at both centres was sampled, and determinations were made of the total nitrogen and the exchangeable potash. The mean results for each treatment are set out in Table XXII.

It will be noted that, at Graeme Hall, the total nitrogen in the soil from none of the manured plots shows any significant differences from the unmanured plot. At Todds, where the total nitrogen in the soil from the unmanured plot is appreciably lower, it is found that all the manured plots and especially those which have been manured with nitrogen and potash, nitrogen, phosphate and potash and vacuum pan molasses, all show higher contents of nitrogen than the no-manure plot. The increases, however, cannot be judged as significant.

At Graeme Hall plantation, manuring with nitrogen and potash, nitrogen, phosphates and potash, and vacuum pan molasses has significantly increased the exchangeable potash in the soil. The increase is less on the completely fertilised plot, where heavier yields of grass have been reaped. At Todds, there has been a significant increase in the exchangeable potash only on the nitrogen plus potash plot. There are small increases on the completely fertilised, and on the vacuum pan molasses plots, but these increases are not significant. It is interesting to speculate as to what has happened to the potash which has been applied in the vacuum pan molasses at Todds. It has evidently not been removed in the grass, and is not held in the soil in an exchangeable form. It is proposed to carry out total potash determinations on these soils and the available and total phosphate will also be estimated.

TABLE XXII.

NITROGEN AND EXCHANGEABLE POTASH IN THE SOIL FROM THE SOUR GRASS MANURIAL PLOTS.

Treatment	Per Cent. Total Nitrogen (Mean of 6 plots)				Mgms. Exchangeable K_2O in 100 gms. Soil (Mean of 6 Plots).			
	Graeme Hall		Todds		Graeme Hall		Todds	
	Per Cent. Total N	Diff. from no Manure Plot	Per Cent. Total N	Diff. from no Manure Plot	Exchangeable K_2O	Diff. from no Manure Plot	Exchangeable K_2O	Diff. from no Manure Plots
O	0.348	—	0.245	—	13.4	—	10.5	—
N	0.309	−0.039	0.265	+0.020	13.5	+0.1	11.4	+0.9
N+P	0.322	−0.026	0.261	+0.016	13.8	+0.4	11.4	+0.9
N+K	0.345	−0.003	0.288	+0.043	19.1	+5.7	14.2	+3.7
N+P+K	0.341	−0.007	0.293	+0.048	17.1	+3.7	12.1	+1.6
V.P.M.	0.348	0.00	0.278	+0.033	20.5	+7.1	12.0	+1.5

Statistical Analyses :

Differences between the mean per cent. nitrogen of 0.56 per cent. at Graeme Hall, and 0.52 per cent. at Todds have a 20:1 chance of being due to treatment.

Differences between the number of milligrams of exchangeable potash in 100 grams of soil of 3.6 for Graeme Hall and 3.5 for Todds have a 20:1 chance of being due to treatment.

SUMMARY.

The manurial trials on sour grass meadows which have been carried out to date indicate that :—

1. Sulphate of ammonia, or sulphate of ammonia plus superphosphate, if applied annually, rapidly result in a depletion of the soil reserves of potash, and this nutrient then becomes the main factor limiting yield. This deficiency of potash results in the grass becoming very susceptible to some rust disease.

2. A manure supplying sulphate of ammonia, superphosphate and potash gives the maximum increase in yield.

3. Two tons of vacuum pan molasses per acre results in no significant increase in yield.

4. Nitrogenous manuring, either alone or in combination with phosphates and potash, although increasing the yield of grass, does not increase the percentage of nitrogen in the grass.

5. The percentage of potash in the ash of the grass is increased by potash manuring, and by manuring with vacuum pan molasses. If sufficient available potash is present in the soil, manuring with nitrogen may also increase the percentage of potash in the ash.

6. The percentage of phosphates in the ash of the grass is increased by phosphatic manuring, and there is some evidence that nitrogenous manuring may also increase the phosphate content. Manuring with nitrogen and potash appears to depress the percentage of phosphate in the grass.

7. As a result of five years' manuring, an application of 67 lb. potash per acre, as muriate of potash, has increased the exchangeable potash in the soil. There is also an increase of exchangeable potash in the soil of the plots receiving vacuum pan molasses. These increases on the plots receiving the complete dressing of artificials, and on those receiving vacuum pan molasses cannot be judged as significant at the red soil centre.

8. The annual applications of 45 lb. nitrogen as sulphate of ammonia for five years has not significantly increased or decreased the nitrogen content of the soil at either centre.

MANURIAL TRIALS WITH SUGAR CANE

By

S. J. SAINT, M.Sc., Ph.D., F.I.C.

I. THE EFFECT OF TIME OF APPLICATION AND AMOUNT OF NITROGEN AS SULPHATE OF AMMONIA ON THE YIELD OF PLANT CANE.

1934—36.

The general practice among planters is to apply 60—80 lb. of quick acting nitrogenous manure—usually sulphate of ammonia—to plant cane. The application is made in two or three doses. The plant cane is planted in November or December, and 15 to 20 lb. nitrogen is applied to the young cane in the following January, together with all of the potash manure. The rest of the nitrogen is either all applied in June or July when the rains begin, or is given in two equal doses; in June or July and August or September.

The effect on the yield of different times of applying sulphate of ammonia, obtained at two trials carried out in 1932-34, has already been reported on.

The trial has been repeated on plant cane, 1934-36, at two further centres. The two centres represented (a) a red soil centre with, under average conditions, a high rainfall; and (b) a black soil centre with, under average conditions, a medium low rainfall.

The trial was laid out in the form of five randomised blocks. There were ten different treatments, particulars of which are given in Table I. It will be noted that all plots received the same amount of potash which was equivalent to 100 lb. K_2O per acre. Three different amounts of sulphate of ammonia were applied, equivalent to 40, 80 and 120 lb. nitrogen per acre respectively. This nitrogen was applied in three different ways, viz. (1) 15 lb. in January and the remainder in July; (2) all in July; and (3) equal amounts in July and September.

TABLE I.

TIME OF APPLICATION AND AMOUNTS OF NITROGEN AND POTASH APPLIED PER ACRE.

Plots	January (lb. per acre)	July (lb. per acre)	September (lb. per acre)
1	100 lb. K_2O 15 lb. N.	25 lb. N	—
2	100 lb. K_2O	40 lb. N	—
3	100 lb. K_2O	20 lb. N	20 lb. N
4	100 lb. K_2O 15 lb. N.	65 lb. N	—
5	100 lb. K_2O	80 lb. N	—
6	100 lb. K_2O	40 lb. N	40 lb. N
7	100 lb. K_2O 15 lb. N.	105 lb. N	—
8	100 lb. K_2O	120 lb. N	—
9	100 lb. K_2O	60 lb. N	60 lb. N
10	—	—	—

Notes on Table I: N=nitrogen applied as Sulphate of Ammonia.
K_2O=potash applied as Muriate of Potash.

The size of each plot was 56 cane holes (approximately 1/30 acre) and the inside 42 holes were cut and weighed in the estimation of yield.

A representative sample of cane, weighing approximately 100 lb. was selected for each different treatment from each block for analysis.

Both the yield and sucrose in juice figures were treated statistically.

RAINFALL.

The total rainfall for the growing season 1934—36 for the red soil centre was 77.09 inches, as compared with an average of 74.4 inches for the same months between the years 1890—1929. At the black soil centre, the rainfall was 72.83 inches for the same growing period as compared with an average of 66 inches for the same months between the years 1890—1929.

It will be noted that, at the red soil centre the rainfall was only about two and a half inches above the average, whilst at the black soil centre it was nearly seven inches above the average. As a result, the rainfall at the black soil centre was only about four inches below that of the red soil centre.

The distribution of the rainfall, which is of as much importance as the total amount on the yield of canes is shown in Figs. I and II. It will be noticed that, although June was a very dry month, the rainfall between July and November was above the average at both centres. It is of interest to note that the total crop reaped in 1936 was a record for the Island, so that the amount and distribution of the rainfall for this growing period must be considered as very favourable. The months of January and February were much drier than the average, as was the whole of the following crop season, and the result was that quantities of canes dried up before they could be reaped. It has been estimated that this loss was equivalent to more than ten thousand tons of sugar.

YIELD RESULTS.

The yield results in terms of tons of cane and sucrose per acre for the means of each treatment for each centre are set out in Table II.

TABLE II.

Plot No.	Red Soil centre (Means of five plots)		Black Soil centre (Means of four plots)	
	Tons cane per acre	lb. sucrose per acre	Tons cane per acre	lb. sucrose per acre
1	32.9	11,081	32.4	11,561
2	34.8	11,762	38.0	13,054
3	33.6	11,152	36.1	12,398
4	35.0	11,829	37.6	12,795
5	34.6	11,459	37.8	12,656
6	36.4	12,260	41.7	14,804
7	36.6	12,217	37.8	12,657
8	37.3	12,212	41.2	14,087
9	36.7	12,261	39.2	13,530
10	34.1	11,374	33.4	11,884

Statistical Analysis:

A difference between the mean yields of 3.3 tons for the red soil centre, and 5.8 tons for the black soil centre has a 20:1 chance of being due to treatment.

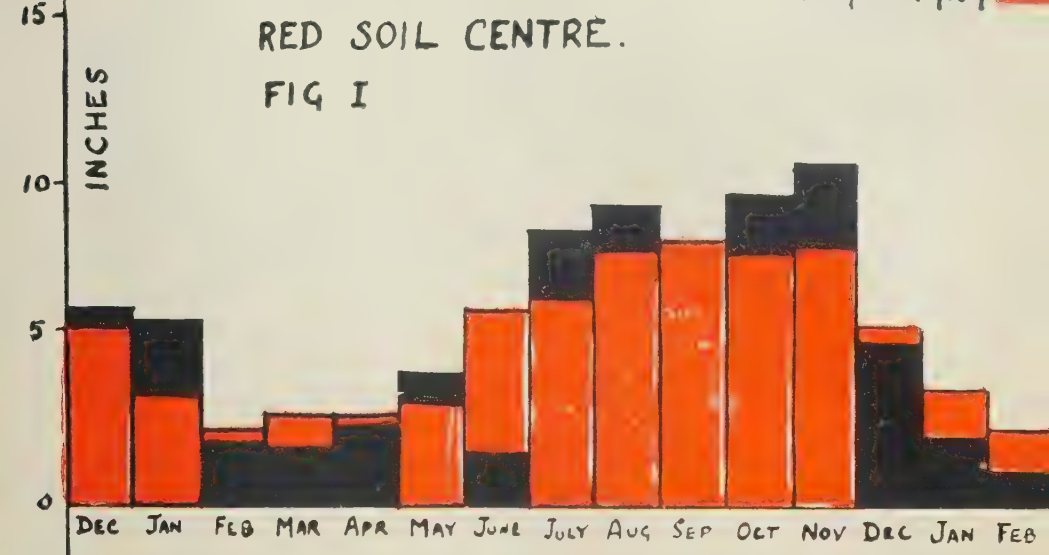
DISTRIBUTION OF RAINFALL.

1934 – 1936

1893 – 1929

RED SOIL CENTRE.

FIG I



BLACK SOIL CENTRE.

FIG II

EFFECTS OF 40, 80 AND 120 lb OF NITROGEN AS SULPHATE OF AMMONIA.

The effects of the different amounts of nitrogen on the yield and per cent. sucrose in juice are shown in Table III.

TABLE III.

Treatment N (lb. per acre)	Red Soil Centre				Black Soil Centre.			
	Tons Cane (Mean of 15)	Diff. from no N plot	Per cent. Sucrose in Juice (Mean of 15)	Diff. from no N plot	Tons Cane (Mean of 12)	Diff. from no N plot	Per cent. Sucrose in Juice (Mean of 12).	Diff. from no N Plot
0	34.1	—	18.56	—	33.4	—	19.07	—
40	33.8	—0.3	18.82	+0.26	35.5	+2.1	18.31	—0.76
80	35.3	+1.2	18.48	—0.08	39.0	+5.6	18.13	—0.94
120	36.9	+2.8	18.43	—0.13	39.4	+6.0	18.01	—1.06

Statistical Analysis:

(*a*) *A difference between the mean yields of 1.9 tons cane for the red soil centre and 3.3 tons cane for the black soil centre has a 20:1 chance of being due to treatment.*

(*b*) *A difference between the mean per cent. sucrose in the juice of 0.4 per cent. for the red soil centre and 0.36 per cent. for the black soil centre has a 20:1 chance of being due to treatment.*

CONCLUSIONS.

Red Soil Centre.

The successive additions of nitrogen as sulphate of ammonia have resulted in small increases in yield over the no-nitrogen plots, but, except for the largest dressing of sulphate of ammonia, the increases can scarcely be regarded as significant.

The different dressings of sulphate of ammonia have had no significant effects on the per cent. sucrose in the juice.

Black Soil Centre.

At this centre the successive additions of nitrogen have had more marked effects in increasing the yield of cane. It is evident, however, that the dressing of 80 lb. nitrogen per acre has given as great an increase in yield as 120 lb. nitrogen. The application of 80 lb. nitrogen per acre, as sulphate of ammonia, has increased the yield by 5½ tons cane per acre.

It will further be noted that the nitrogenous dressings have resulted in a considerable depression of the per cent. sucrose in the juice. The juice from the plots receiving 80 and 120 lb. nitrogen per acre contains about 1 per cent. less sucrose than does the juice from the no-nitrogen plot.

EFFECTS OF DIFFERENT TIMES OF APPLICATION OF NITROGEN AS SULPHATE OF AMMONIA.

As already noted, the nitrogen was applied in three different ways, viz. (a) 15 lb. in January and the remainder in July; (b) all in July as one application; and (c) half in July and half in September. The yield results in terms of tons of cane per acre and per cent. sucrose in juice are set out in Tables IV and V.

TABLE IV.

EFFECT OF DIFFERENT TIMES OF APPLICATION OF NITROGEN ON YIELD AND PER CENT. SUCROSE IN JUICE.
RED SOIL CENTRE.

Treatment (lb. N per acre)	January and July.		July		July and September.	
	Tons Cane (Mean of 5)	Per cent sucrose in juice (Mean of 5)	Tons Cane (Mean of 5)	Per cent sucrose in juice (Mean of 5)	Tons Cane (Mean of 5)	Per cent sucrose in juice (Mean of 5)
40	32.9	19.00	34.8	18.84	33.6	18.61
80	35.0	18.47	34 6	18.42	36.4	18.56
120	36.6	18.56	37.3	18.39	36.7	18.35
Mean of 15 Plots	34.8	18.68	35.6	18.55	35.6	18.51

Statistical Analysis:

A difference in the means of 15 plots of 1.9 tons cane or 0.4 per cent. sucrose in juice has a 20:1 chance of being due to treatment.

TABLE V.

BLACK SOIL CENTRE.

Treatment. (lb. N per acre)	January and July.		July		July and September.	
	Tons Cane (Mean of 4)	Per cent sucrose in juice (Mean of 4)	Tons Cane (Mean of 4)	Per cent sucrose in juice (Mean of 4)	Tons Cane (Mean of 4)	Per cent sucrose in juice (Mean of 4)
40	32.4	18.43	38.0	18.27	36.1	18.23
80	37.6	18.20	37.8	17.74	41.7	18.44
120	37.8	17.89	41.2	17.90	39.2	18.24
Mean of 12 plots	35.9	18.17	39.0	17.97	39.0	18.30

Statistical Analysis:

A difference in the means of 12 plots of 3.3 tons cane or 0.36 per cent. sucrose in juice has a 20:1 chance of being due to treatment.

CONCLUSIONS.

Red Soil Centre.

A consideration of the figures given in Table IV indicates that there is no difference in yield between the plots receiving all their nitrogen in July and those receiving the nitrogen in two equal applications in July and September. The yield of the plots receiving a small amount of nitrogen in the "early cane manure" is less than that of the other plots, but the difference is not significant.

There is no significant effect on the quality of the juice as a result of varying the times of application of the nitrogenous manure.

Black Soil Centre.

The same remarks may be applied to the results obtained at this centre. The yields from the plots receiving nitrogen in July or in July and September are the same. The yield from the plots receiving part of the nitrogen in January is 3 tons per acre less than that of the others, but the difference can scarcely be considered a significant one.

There are no significant differences between the per cent. sucrose in the juices from the cane reaped from the differently treated plots.

GENERAL SUMMARY.

As a matter of convenience, the results obtained in the 1932–34 trials and in the present trials are summarised in Table VI. The mean results of these

trials indicate that there is no advantage in giving a small application of sulphate of ammonia in January, or of splitting the main application of sulphate of ammonia into two doses. The average yield results of the experiments under consideration indicate that the best results are obtained by giving the sulphate of ammonia in one application in July or when the rainy season commences.

TABLE VI.

EFFECT OF TIME OF APPLICATION OF SULPHATE OF AMMONIA ON YIELD OF PLANT CANES.

District	Estate	Year	Time of Application		
			Jany and July	July	July and Sept.
			(tons per acre)	(tons per acre)	(tons per acre)
Black Soil ..	Belle	1932–34	33.9	33.4	30.0
„ „ .	Valley	1934–36	35.9	39.0	39.0
Red Soil ..	Ashbury	1932–34	33.9	34.8	35.1
„ „ ..	Colleton	1934–36	34.8	35.6	35.6
Means of 57 Plots			34.6	35.7	34.9

II. THE EFFECT OF VARYING COMBINATIONS OF NITROGEN AND POTASH ON THE YIELD AND PER CENT. SUCROSE IN JUICE OF SUGAR CANE.

(a) TYPE I.

The trials on plant cane which were described in the October, 1935 issue of this Journal, were continued on the following crop of ratoon cane.

The centres were (a) Walkes Spring, a red soil estate with, on the average, a high rainfall and (b) River, a black soil estate with, on the average, a low rainfall.

The lay-out was in the form of six randomised blocks. There were nine treatments. The varying amounts of nitrogen and potash applied were equivalent to 0, 60, and 120 lb per acre. The size of each plot was 56 cane holes (approximately 1/36 acre) and the inside 42 holes were cut and weighed in the estimation of yield. For sucrose determinations, a representative sample of cane weighing approximately 100 lb was selected for each treatment from each block for analysis, making a total of 54 samples.

RAINFALL.

The rainfall for the growing period, April 1935—March 1936 measured 64.2 inches at the red soil centre, as compared with an average of approximately 75 inches for the same months between the years 1890 –1929, and 41.5 inches at the black soil centre, as compared with an average of 42 inches for the same months between the years 1890—1929. It will be noted that the rainfall was somewhat below average at the red soil centre, and closely approaching the average at the black soil centre. The distribution may be taken as similar to that shown in Figs. I and II.

YIELD RESULTS.

The yield results, in terms of tons of cane and the percentage sucrose in the juice, are set out in Table VII for the means of six plots of each treatment for each centre.

TABLE VII.

Plot No.	Treatment (per acre).		Means of six plots.			
			Black Soil Centre.		Red Soil Centre.	
	lb. K_2O	lb. N.	Tons cane	Per cent. sucrose in juice.	Tons cane	Per cent. sucrose in juice.
1	0	0	12.5	18.02	14.4	21.82
2	0	60	14.3	18.10	17.4	21.96
3	0	120	16.5	18.14	17.3	22.04
4	60	0	19.5	18.07	20.6	22.19
5	60	60	22.5	18.28	22.6	21.78
6	60	120	24.0	18.16	21.9	21.99
7	120	0	28.2	17.92	23.4	21.84
8	120	60	24.2	17.98	25.2	22.02
9	120	120	29.9	18.17	27.3	21.95

N=Nitrogen as Sulphate of Ammonia. K=potash as Muriate of Potash.

Statistical Analysis:

A difference between the mean yields of 5.2 tons cane or 0.57 per cent. sucrose in juice for the black soil centre, and 3.6 tons cane or 0.41 per cent. sucrose in juice for the red soil centre, has a 20:1 chance of being due to treatment.

The effects of the different doses of nitrogen and potash on the yield of cane and per cent. sucrose in juice can be more clearly seen if the results are set out in more detail. This has been done in Tables VIII and IX.

TABLE VIII.

EFFECT OF VARYING AMOUNT OF NITROGEN ON YIELD AND PER CENT. SUCROSE IN JUICE.

Treatment.		Black Soil Centre.				Red Soil Centre.			
lb. N.	lb. K	Yield (tons cane)	Mean Difference.	Per Cent. Sucrose in Juice	Mean Difference.	Yield (tons cane)	Mean Difference.	Per Cent. Sucrose in Juice	Mean Difference.
EFFECT OF 60 lb NITROGEN.									
0	0	12.5	+1.8	18.02	+0.08	14.4	+3.0	21.82	+0.14
60	0	14.3		18.10		17.4		21.96	
0	60	19.5	+3.0	18.07	+0.21	20.6	+2.0	22.19	—0.41
60	60	22.5		18.28		22.6		21.78	
0	120	28.2	—4.0	17.92	+0.06	23.4	+1.8	21.04	+0.18
60	120	24.2		17.98		25.2		22.02	
Differences between Mean of 18 plots...			+0.29		+0.12		+2.27		—0.03
EFFECT OF 120 lb NITROGEN.									
0	0	12.5	+4.0	18.02	+0.12	14.4	+2.9	21.82	+0.22
120	0	16.5		18.14		17.3		22.04	
0	60	19.5	+4.5	18.07	+0.09	20.6	+1.3	22.19	—0.20
120	60	24.0		18.16		21.9		21.99	
0	120	28.2	+1.7	17.92	+0.25	23.4	+3.9	21.84	+0.11
120	120	29.9		18.17		27.3		21.95	
Differences between Mean of 18 plots...			+3.40		+0.15		+2.70		+0.03

TABLE IX.

EFFECT OF VARYING AMOUNTS OF POTASH ON THE YIELD AND PER CENT SUCROSE IN JUICE.

Treatment		Black Soil Centre				Red Soil Centre			
lb. N.	lb. K_2O	Yield (tons cane)	Mean Diff.	Per Cent. Sucrose in Juice	Mean Diff.	Yield (tons cane)	Mean Diff.	Per Cent. Sucrose in Juice	Mean Diff.
EFFECT OF 60 LB. POTASH.									
0	0	12.5	+7.0	18.02	+0.05	14.4	+6.2	21.82	+0.37
0	60	19.5		18.07		20.6		22.19	
60	0	14.3	+8.2	18.10	+0.18	17.4	+5.2	21.96	—0.18
60	60	22.5		18.28		22.6		21.78	
120	0	16.5	+7.5	18.14	+0.02	17.3	+4.6	22.04	—0.05
120	60	24.0		18.16		21.9		21.99	
Differences between Means of 18 plots			+7.6		+0.08		+5.3		—0.05
EFFECT OF 120 LB. POTASH.									
0	0	12.5	+15.7	18.02	—0.10	14.4	+ 9.0	21.82	+0.02
0	120	28.2		17.92		23.4		21.84	
60	0	14.3	+ 9.9	18.10	—0.12	17.4	+ 7.8	21.96	+0.06
60	120	24.2		17.98		25.2		22.02	
120	0	16.5	+13.4	18.14	—0.03	17.3	+10.0	22.04	—0.09
120	120	29.9		18.17		27.3		21.95	
Differences between Means of 18 plots			+13.0		—0.06		+ 8.9		0.00

Statistical Analysis of Tables VIII and IX.

The following differences between the mean yields have a 20:1 chance of being due to treatment :—

	Difference between means of 6 plots.		Difference between means of 18 plots	
	Tons cane	Per cent. sucrose in Juice	Tons cane	Per cent sucrose in Juice
Black Soil Centre	5.2	0.57	3.0	0.27
Red Soil Centre	3.6	0.41	2.1	0.24

In order to compare the results with those obtained with the plant canes (1933—35), the combined results are summarised in Tables X and X1.

TABLE X.

EFFECT OF VARYING DOSES OF NITROGEN ON YIELD AND PER CENT SUCROSE IN JUICE OF PLANT CANE AND RATOONS.

BLACK SOIL CENTRE.

Treatment per acre	Differences from No-Nitrogen Plots. (Means of 18)			
	Plant Canes (1933-35.		Ratoons (1935–36)	
	Yield (Tons per Acre)	Per cent. sucrose in juice	Yield (Tons per Acre)	Per cent sucrose in juice
60 lb. Nitrogen	—0.50	+0.18	+0.29	+0.12
120 lb. Nitrogen	—1.07	+0.04	+3.40	+0.15
RED SOIL CENTRE.				
60 lb. Nitrogen	+1.03	+0.09	+2.27	—0.03
120 lb. Nitrogen	+0.50	—0.35	+2.70	+0.03

TABLE XI.

EFFECT OF VARYING DOSES OF POTASH ON YIELD AND PER CENT. SUCROSE IN JUICE OF PLANT CANE AND RATOONS.

BLACK SOIL CENTRE.

Treatment per Acre.	Differences from No-Potash Plot (Means of 18.)			
	Plant canes (1933-35).		Ratoons (1935-36).	
	Yield (tons per acre).	Per cent. Sucrose in Juice	Yield (tons per acre).	Per Cent. Sucrose in Juice
60 lb. Potash	+0.17	—0.04	+7.6	+0.08
120 lb. Potash	+0.27	+0.04	+13.0	—0.06
RED SOIL CENTRE.				
60 lb. Potash	+2.53	+0.01	+5.3	—0.05
120 lb. Potash	+4.30	+0.04	+8.9	0.00

CONCLUSIONS :

Black Soil Centre : The yield of plant canes at the black soil centre was limited to about 14 tons cane per acre, owing to an exceptionally dry year. The results of the experiment indicated that, under these conditions sulphate of ammonia might actually depress the yield. The application of potash gave small increases in yield which could not be considered significant.

With the ratoons, there was little response to the nitrogenous dressings, but potash has definitely proved to be lacking on this estate. The application of 60 lb. potash per acre increased the yield by 7½ tons cane, whilst the application of 120 lb. potash increased the yield by 13 tons cane per acre. Neither the application of nitrogen nor potash have had any significant effect on the per cent. sucrose in juice, either with the plant or ratoon cane.

Red Soil Centre : The cane at this centre has also shown marked responses to potash manuring. The plant cane gave increases of 2½ tons cane per acre with 60 lb. potash, and nearly 4½ tons cane per acre with 120 lb. potash. As would be expected, the response to potash manuring is even more marked in the ratoon cane.

60 lb. potash has increased the yield of the no-potash plots by 5½ tons cane per acre, whilst 120 lb. potash has increased the yield by 9 tons cane per acre.

The nitrogenous dressings have had only a small effect in increasing the yield; it is evident that the main need, at both these centres, is potash.

The per cent. sucrose in the juice has not been affected to any significant extent by either the nitrogen or potash manuring.

(b) TYPE II.

RATOONS, 1935-36:

This trial was a continuation of the experiment reaped as plant cane in 1935, and reported on in the October, 1935 number of this Journal.

The centre was at Foursquare Plantation, which is a black soil district representative of medium low rainfall conditions. The trial was in the form of four randomised blocks. The plots were treated the same as for the plant cane, i.e., there were four different applications of nitrogen and potash. The varying amounts of nitrogen and potash applied were equivalent to 0, 40, 80 and 120 lb. per acre respectively. The size of each plot was 56 cane holes, and the inside 42 holes were cut and weighed in the estimation of yield. For sucrose determinations in the juice, a representative sample of approximately 100 lb. cane was selected from each plot for analyses, making a total of 64 samples.

The rainfall for the growing period April, 1935—March, 1936, was 54.9 inches, as compared with an average of 50 inches for the same months between the years 1890—1929. The distribution of the rainfall was very favourable, and is similar to that shown in Fig. II.

The yield results in terms of tons of cane and per cent. sucrose in juice for the means of the individual plots are set out in Table XII. It will be noted that the completely manured plots of the ratoons yielded better than the same plots in plant cane reaped the previous year.

TABLE XII.

	Treatment per acre.		Plant Cane (1933-35)		Ratoons (1935-36).	
Plot No.	K_2O lb.	N (lb)	Tons Cane.	Per Cent. Sucrose.	Tons Cane.	Per Cent. Sucrose.
1	0	0	21.0	15.89	10.5	18.59
2	0	40	24.7	16.11	20.1	18.88
3	0	80	25.9	16.11	21.4	19.09
4	0	120	27.1	15.74	31.3	18.97
5	40	0	20.7	16.02	10.2	19.11
6	40	40	24.1	16.11	17.9	19.34
7	40	80	26.5	16.11	24.5	18.89
8	40	120	28.8	15.68	30.8	18.65
9	80	0	21.2	16.05	9.9	18.90
10	80	40	25.2	16.36	19.0	19.13
11	80	80	25.9	16.13	26.6	18.99
12	80	120	26.6	16.41	31.7	19.22
13	120	0	20.0	16.05	9.7	19.02
14	120	40	24.3	16.00	18.4	18.97
15	120	80	26.8	16.04	24.8	19.14
16	120	120	25.8	16.37	30.2	18.55

K_2O=Potash as Muriate of Potash.

N.=Nitrogen as Sulphate of Ammonia.

Statistical Analysis:

A difference between the mean yields of 3.4 tons cane or 0.55 per cent. sucrose in juice for the plant canes and 4.9 tons cane or 0.48 per cent. sucrose in juice for the ratoons has a 20:1 chance of being due to treatment.

The effects of the different doses of nitrogen and potash on the yield and per cent. sucrose in juice are considered separately in Tables XIII and XIV where the differences between the means of sixteen plots are given.

TABLE XIII.

EFFECT OF VARYING AMOUNTS OF NITROGEN ON YIELD AND PER CENT. SUCROSE IN JUICE.

Treatment (per acre)	Differences from No-Nitrogen Plots.			
	Plant Canes (1933—35)		Ratoons (1935—36)	
	Yield (tons)	Per Cent. Sucrose.	Yield (tons)	Per Cent. Sucrose.
40 lb. Nitrogen ..	+3.85	+0.14	+ 8.72	+0.18
80 lb. Nitrogen ..	+5.55	+0.09	+14.25	+0.12
120 lb. Nitrogen ..	+6.35	+0.05	+20.92	—0.06

TABLE XIV.

EFFECT OF VARYING AMOUNTS OF POTASH ON YIELDS AND PER CENT. SUCROSE IN JUICE

Treatment (per acre)	Differences from No-Potash plots.			
	Plant Canes (1933—35)		Ratoons (1935—36)	
	Yield (tons)	Per Cent. Sucrose	Yield (tons)	Per Cent. Sucrose
40 lb. Potash ..	+0.35	+0.02	+0.03	+0.12
80 lb. Potash ..	+0.05	+0.27	+0.75	+0.18
120 lb. Potash ..	+0.45	+0.15	—0.05	+0.04

Statistical Analysis of Tables XIII and XIV :

A difference between the mean yields of 1.72 tons cane, or 0.28 per cent. sucrose in juice for the plant canes and 2.44 tons cane, or 0.24 per cent. sucrose in juice for the ratoons, has a 20:1 chance of being due to treatment.

CONCLUSIONS :

The results of this trial are quite different from the results obtained in the similar trial reported on earlier in this section. At this centre, no potash deficiency in the soil is apparent, but very large increases in yield have been obtained with sulphate of ammonia.

With the plant cane, 80 lb. nitrogen appeared to be the maximum economic dressing, but with the ratoons, the 120 lb. dressing of nitrogen has given an increased yield of 20 tons cane over the unmanured plot, and 6½ tons cane over the plot receiving 80 lb. nitrogen.

The potash manuring has had no significant effect on the yield of either plant or ratoon cane. Enquiries have elicited the information that it has been the custom on this plantation, for many years to put vacuum pan molasses on the pens, and undoubtedly this practice has built up a considerable reserve of potash in the soil.

ANALYSES OF SOIL FROM MANURIAL TRIAL PLOTS.

In view of the different response obtained with potash and nitrogen fertilisers at these centres, it was decided to take soil samples from the plots for determination of exchangeable potash and total nitrogen.

The analyses of the soil samples taken from each treatment on four of the six blocks at Walkes Spring Plantation, where a big response to potash but little or no response to nitrogen, was obtained, are shown in Tables XV and XVI.

TABLE XV.

MGMS. EXCHANGEABLE POTASH IN 100 GMS. OF SOIL FROM PLOTS ON WALKES SPRING MANURIAL TRIAL.

Plots	Treatment	Block Number				Mean
		1	2	5	6	
1	N_0 K_0	14.3	11.1	10.1	9.2	11.2
2	N_1 K_0	10.6	19.0	11.4	7.7	12.2
3	N_2 K_0	12.4	12.7	9.6	9.1	11.0
4	N_0 K_1	11.5	11.1	8.5	8.1	10.1
5	N_1 K_1	11.1	10.6	12.4	9.0	10.8
6	N_2 K_1	16.2	11.4	9.2	10.8	11.9
7	N_0 K_2	11.7	11.8	11.4	11.3	11.6
8	N_1 K_2	14.2	9.8	12.7	9.7	11.6
9	N_2 K_2	11.6	9.1	10.7	11.1	10.6

TABLE XVI.

TOTAL NITROGEN IN SOIL FROM PLOTS ON WALKES SPRING MANURIAL TRIAL.

Plots	Treatment	Block Number				Mean
		1	2	5	6	
1	N_0 K_0	0.224	0.217	0.210	0.232	0.221
2	N_1 K_0	0.218	0.225	0.214	0.230	0.222
3	N_2 K_0	0.224	0.207	0.214	0.228	0.218
4	N_0 K_1	0.227	0.210	0.213	0.228	0.220
5	N_1 K_1	0.227	0.209	0.216	0.221	0.218
6	N_2 K_1	0.231	0.210	0.230	0.225	0.224
7	N_0 K_2	0.224	0.213	0.218	0.218	0.218
8	N_1 K_2	0.231	0.204	0.224	0.225	0.221
9	N_2 K_2	0.223	0.210	0.225	0.218	0.219

The analyses of the soil samples taken from each treatment of the four blocks at Foursquare Plantation, where a large response to nitrogen, but no response to potash manuring was obtained are shown in Tables XVII and XVIII.

TABLE XVII

MGMS. EXCHANGEABLE POTASH IN 100 GMS. SOIL FROM PLOTS ON FOURSQUARE MANURIAL TRIAL.

Plot	Treatment	Block Number				Mean
		1	2	3	4	
1	N_0 K_0	21.4	21.4	28.3	21.2	23.1
2	N_1 K_0	22.1	18.9	19.2	28.3	22.1
3	N_2 K_0	14.0	21.5	17.9	18.2	17.9
4	N_3 K_0	19.8	17.3	14.3	20.0	17.9
5	N_0 K_1	20.1	28.5	22.2	17.6	22.2
6	N_1 K_1	21.8	34.9	20.7	27.5	26.2
7	N_2 K_1	26.8	21.7	18.2	18.9	21.4
8	N_3 K_1	16.7	21.3	21.6	17.7	19.3
9	N_0 K_2	20.1	21.6	22.6	26.5	22.7
10	N_1 K_2	18.2	19.4	19.6	25.6	20.7
11	N_2 K_2	18.5	20.4	20.4	25.2	21.1
12	N_3 K_2	17.3	19.6	24.0	21.2	20.5
13	N_0 K_3	28.0	22.9	20.1	20.8	23.0
14	N_1 K_3	21.1	16.6	16.4	30.8	21.2
15	N_2 K_3	20.8	18.2	14.3	21.1	18.6
16	N_3 K_3	23.3	21.8	30.5	20.4	24.0

TABLE XVIII.

TOTAL NITROGEN IN SOIL FROM PLOTS ON FOURSQUARE MANURIAL TRIAL.

Plot	Treatment	Block Number 1	2	3	4	Mean
1	N_0 K_0	0.125	0.127	0.130	0.116	0.125
2	N_1 K_0	0.133	0.133	0.123	0.115	0.126
3	N_2 K_0	0.129	0.140	0.119	0.120	0.127
4	N_3 K_0	0.127	0.140	0.118	0.119	0.126
5	N_0 K_1	0.123	0.139	0.119	0.120	0.125
6	N_1 K_1	0.127	0.136	0.118	0.115	0.124
7	N_2 K_1	0.133	0.130	0.113	0.112	0.122
8	N_3 K_1	0.127	0.127	0.116	0.120	0.123
9	N_0 K_2	0.123	0.134	0.125	0.112	0.124
10	N_1 K_2	0.126	0.133	0.120	0.120	0.125
11	N_2 K_2	0.129	0.133	0.118	0.120	0.125
12	N_3 K_2	0.127	0.143	0.127	0.115	0.128
13	N_0 K_3	0.127	0.129	0.126	0.112	0.124
14	N_1 K_3	0.129	0.123	0.123	0.113	0.122
15	N_2 K_3	0.125	0.123	0.116	0.113	0.119
16	N_3 K_3	0.129	0.123	0.129	0.120	0.125

It is evident from a consideration of Tables XV—XVIII that there is little difference in analysis between the soil from the differently treated plots. This is more clearly brought out in Tables XIX and XX, where the average figures are set out.

TABLE XIX.

MGMS. EXCHANGEABLE POTASH IN MANURIAL TRIAL PLOTS

Treatment of plant cane and ratoons per acre.	Walkes Spring (Mean of 12)	Foursquare (Mean of 16)
No Potash	11.5	20.3
40 lb. Potash	—	22.3
60 lb. „	10.9	—
80 lb. „	—	21.3
120 lb. „	11.3	21.7

TABLE XX.

TOTAL NITROGEN IN MANURIAL TRIAL PLOTS.

Treatment of plant cane and ratoons per acre.	Walkes Spring (Mean of 12)	Foursquare (Mean of 16)
No Nitrogen	0.220	0.125
40 lb. „	—	0.124
60 lb. „	0.220	—
80 lb. „	—	0.123
120 lb. „	0.220	0.126

The figures in Tables XIX and XX show that at Foursquare Plantation, where no response to potash manuring was obtained, the exchangeable potash was nearly double the amount obtained at Walkes Spring Plantation, where the manurial trial showed a definite potash deficiency in the soil. These figures support earlier work which indicate that, on the coral limestone soils of Barbados, cane would respond to potash manuring if the exchangeable potash in the soil fell below 14 to 15 milligrams per 100 grams of soil.

The total nitrogen figures are also interesting. At Walkes Spring Plantation, the total nitrogen figures are nearly double those obtained on the plots at Foursquare Plantation. The figures correspond to the way in which cane growing on these soils responded to applications of nitrogenous manure.

It does not always follow, however, that cane growing on soils containing over 0.2 per cent. of nitrogen will respond only slightly to sulphate of ammonia. Analyses have been made of soil samples from plots at Mount Wilton

Plantation, where three crops of ratoons were grown, and where the plots had been treated with varying dressings of nitrogen and potash each year. This trial was reported on in the October, 1935 number of this Journal. Samples of soil were taken from the plots after the final crop of ratoons had been reaped, and the results of these analyses have not yet been recorded. The yield results of this trial are summarised in Table XXI, where it will be seen that responses to sulphate of ammonia were obtained each year, and more especially in the last year, when the plots receiving 80 lb. nitrogen per acre outyielded the no-nitrogen plots by nearly 8 tons cane. The potash results are also very interesting. For the first two years, potash manuring had no effect on the yield. In the third year, however, there was a considerably smaller yield on the plots receiving no potash and those which had received only 40 lb. potash per acre. It was, therefore, apparent that, on this soil, the reserves of potash had been exhausted by two crops of cane on the no-potash plots, and that an annual application of 40 lb. potash per acre was insufficient to keep up the reserves of this nutrient.

TABLE XXI.

EFFECT OF VARYING DOSES OF NITROGEN AND POTASH ON THE YIELD OF RATOONS. (MOUNT WILTON.)

Treatment per acre Nitrogen or Potash.	Differences of Nitrogen Plots from No-Nitrogen Plots. (Tons Cane, Means of 16).			Differences of Potash Plots from No-Potash Plots. (Tons Cane, Means of 16).		
	1932-33	1933-34	1934-35.	1932-33	1933-34	1934-35.
40 lb.	+1.6	+0.2	+3.0	—1.9	+1.1	+3.7
80 lb.	+2.3	+3.1	+7.7	—0.7	+0.4	+6.7
120 lb.	+3.2	+3.8	+8.8	—1.4	—0.0	+5.4

The mean analyses of the soil from the plots which were sampled in 1935, in respect of exchangeable potash and total nitrogen, are given in Table XXII.

TABLE XXII.

ANALYSES OF MANURIAL TRIAL PLOTS.
(MOUNT WILTON)

Treatment per acre.	Per cent. Total Nitrogen (Means of 8).	Treatment per acre.	Mgms. Exchangeable Potash per 100 gms Soil. (Means of 8)
0 Nitrogen....	0.228	0 Potash	14.7
40 lb. „	0.222	40 lb. „	15.7
80 lb. „	0.223	80 lb. „	16.3
120 lb. „	0.221	120 lb. „	19.2

It will be noted from Table XXII that there is little difference between the total nitrogen figures obtained from the differently treated plots. They are somewhat similar to those obtained from the soil on the plots at Walkes Spring Plantation, but, although relatively high, the ratoon cane on these plots showed a good response to sulphate of ammonia.

The potash figures are very interesting and bear out the conclusions that were deduced from the yield results of the cane growing on these plots. There is a definite gradation in exchangeable potash status from 14.7 milligrams per 100 grams of soil in the plots which had grown three crops of cane without potash manuring, up to 19.2 milligrams per 100 grams of soil in the plots which had received 120 lb. K. O per acre each year. The yield of cane from the plots containing less than 16 milligrams of exchangeable potash per 100 grams of soil was limited by a deficiency of potash in the soil.

SUMMARY.

1. The results of trials carried out to date on the best time to apply sulphate of ammonia to sugar cane indicate that the sulphate of ammonia should be applied in one application in June, i.e. when the rainy season commences. There is no advantage in applying a small dose of nitrogen in January or in splitting the main nitrogenous application into two.
2. The response of sugar cane to nitrogenous and/or potash manures, depends very largely on the previous manurial history of the soil. Results are reported which show, at one centre, large increases in yield of sugar cane as a result of applications of potash, but small increases from applications of nitrogenous manures. At another centre, of similar soil type, exactly opposite responses were obtained.
3. Analyses carried out on soil samples from the manurial trial plots support previous findings, and indicate that, that, on the coral limestone soils of Barbados, sugar cane will respond to potash manuring if the exchangeable potash in the soil falls below 14—16 mgms. per 100 grams soil.
4. Responses to nitrogenous fertilizers are not so readily defined by analyses giving the total nitrogen content of the soil. Soil containing 0.125 per cent. total nitrogen proved deficient in available nitrogen, and sugar cane growing on this soil gave big increases in yield as a result of nitrogenous manuring. Sugar cane growing on soil containing over 0.2 per cent total nitrogen gave responses to sulphate of ammonia in one case but not in another.

SUGAR CANE SPACING EXPERIMENTS.

By

G. C. STEVENSON, B.A., A.I.C.T.A.

Three sugar cane spacing experiments were reaped during the 1936 crop; in plant canes at Bushy Park, and in first ratoons at Lower Estate and Mount Wilton respectively. The results of these experiments are given in detail below.

I. BUSHY PARK—PLANT CANES.

This was an experiment designed to test the effect of four spacing distances —6ft x 6ft, 5ft x 5ft, 6ft x 3ft, and 5ft x 3ft—on the tonnage of cane, the number of canes both sound and rotten, and the per cent. sucrose in the juice.

The variety used was B.2935, and the spacings were arranged in randomised blocks, replicated four times. The experiment was reaped on March 23rd., 1936.

RESULTS.

(i) Yield of canes in tons per acre.

Blocks	Spacings				Total	Mean
	6′ x 6′	5′ x 5′	6′ x 3′	5′ x 3′		
1	33.53	33.16	38.83	42.21	147.73	36.93
2	32.29	35.10	36.90	34.57	138.86	34.71
3	35.43	35.66	34.93	34.97	140.99	35.25
4	35.89	32.70	31.84	39 27	139.70	34.92
Total ..	137.14	136.62	142.50	151.02	567.28	
Mean ..	34.28	34.15	35.62	37.75		35.45

Statistics: A difference of 3.44 tons per acre between spacing means may be regarded as highly significant.

(ii) Number of sound canes per plot.

Blocks	Spacings.				Total	Mean
	6′ x 6′	5′ x 5′	6′ x 3′	5′ x 3′		
1	531	599	676	691	2497	624.2
2	511	554	567	584	2216	554.0
3	587	625	604	635	2451	612.7
4	536	526	538	651	2251	562.7
Total ..	2165	2304	2385	2561	9415	
Mean ..	541.2	576.0	596.2	640.2		588.4

Statistics: A difference of 63 canes per plot between the spacing means may be regarded as highly significant.

(iii) Number of rotten canes per plot.

Blocks	Spacings.				Total	Mean
	6′ x 6′	5′ x 5′	6′ x 3′	5′ x 3′		
1	72	165	72	131	440	110.0
2	77	137	78	84	376	94.0
3	49	55	100	60	264	66.0
4	116	182	112	61	471	117.7
Total ..	314	539	362	336	1551	
Mean ..	78.5	134.7	90.5	84.0		96.9

(iv) Per cent. sucrose in juice.

Blocks	Spacings				Total	Mean
	6′ x 6′	5′ x 5′	6′ x 3′	5′ x 3′		
1	18.42	17.69	18.24	17.10	71.45	17.86
2	16.56	16.89	18.58	17.90	69.93	17.48
3	18.42	18.43	17.89	17.72	72.46	18.11
4	18.75	17.70	18.33	18.32	73.10	18.27
Total ..	72.15	70.71	73.04	71.04	286.94	
Mean ..	18.04	17.68	18.26	17.76		17.93

Statistics: A difference of 0.956 per cent. sucrose in juice between spacing means may be regarded as highly significant.

CONCLUSIONS.

In regard to tonnage of canes, it is seen that the closest spacing (5′ x 3′) is significantly better than either of the two widest spacings (6′ x 6′ and 5′ x 5′), but not significantly better than the 6′ x 3′ spacing.

This result is in agreement with those of previous experiments in these soils, which have shown that higher tonnages of plant cane are to be expected from closer spacings than those generally used in commercial plantings.

In this experiment, further data are available, showing that the main contributory factor to the increased tonnage is the number of canes produced. In the closest spacing (5′ x 3′), the cane number is significantly greater than that in either of the widest spacings (6′ x 6′ and 5′ x 5′), but not significantly greater than that in the 6′ x 3′ spacing.

In regard to loss of canes through rotting and drying out, which was severe in the 1936 crop, it is seen that there was little difference between the four spacings. The figures suggest, indeed, that the loss is least severe in the closest spacing. This suggestion is even more pronounced when rotten canes are calculated as a percentage of total canes produced.

The effect of spacing on per cent. sucrose in juice was small. There were no significant differences in this respect between the means of any of the spacings.

II. LOWER ESTATE—FIRST RATOONS.

This experiment was planted in 1933, and reaped as plant canes in 1935. The results of the plant cane experiment were published in the Department of Science and Agriculture, Barbados, Agricultural Journal Vol. 4 No. 2.

There were two spacings — 5′ x 5′ and 5′ x 2½′ — planted in blocks replicated six times. The variety was B.726. The first ratoons were reaped on March 23rd., 1936.

RESULTS.

Blocks	Tons per acre		Sound canes per plot.		Rotten canes per plot.		Per cent. sucrose in juice.	
	5′ x 2½′	5′ x 5′	5′ x 2½′	5′ x 5′	5′ x 2½′	5′ x 5′	5′ x 2½′	5′ x 5′
1	35.86	32.29	783	717	162	94	21.96	22.12
2	31.49	30.89	776	729	99	63	21.63	21.62
3	26.57	27.17	871	811	160	98	21.09	20.77
4	33.74	32.88	737	696	53	35	21.71	22.80
5	27.91	28.62	832	659	46	23	21.76	22.11
6	24.47	26.71	824	798	174	60	20.49	20.90
Total	180.04	178.56	4,823	4,410	694	373	128.64	130.32
Mean	30.01	29.76	803.8	735.0	115.7	62.2	21.44	21.72

Statistics: Significant differences between spacing means:—

Tons per acre	.. ..	1.60
Number of sound canes	.. ..	43.20
Per cent. sucrose in juice	..	0.38

CONCLUSIONS.

Although the mean plot weight for the closer spacing was greater than that for the wider, this difference is not statistically significant.

Although the number of sound canes was significantly greater in the closer spacing, there was also in this experiment, a considerably greater loss of canes through rotting in these plots.

The slight difference between plot means for per cent. sucrose in juice in favour of the wider spacing, is not statistically significant.

III. MOUNT WILTON—FIRST RATOONS.

This experiment was also planted in 1933, and reaped as plant canes in 1935. The results of the plant cane experiment were published in the Department of Science and Agriculture, Barbados, Agricultural Journal, Vol. 4, No. 2. There were two spacings—5′ x 2½′ and 5′ x 5′—planted in blocks replicated six times. The variety was B.H.10(12). The experiment was reaped as first ratoons on April 8th, 1936.

RESULTS.

Blocks	Tons per acre		Sound canes per plot		Rotten canes per plot		Per cent sucrose in juice.	
	5′ x 2½′	5′ x 5′	5′ x 2½′	5′ x 5′	5′ x 2½′	5′ x 5′	5′ x 2½′	5′ x 5′
1	32.55	31.68	591	587	306	213	20.89	20.80
2	30.91	31.42	544	542	29	52	20.11	20.63
3	29.28	29.22	670	652	94	64	20.81	21.05
4	37.17	31.18	646	601	274	184	21.32	21.41
5	31.42	30.43	593	543	115	45	20.01	20.21
6	31.89	32.64	730	648	106	88	19.91	20.89
Total ..	193.22	186.57	3774	3573	924	646	123.05	124.99
Mean ..	32.20	31.09	629.0	595.5	154.0	107.7	20.51	20.83

Statistics: Significant differences between spacing means:—

Tons per acre	2.02
Number of sound canes	25.40
Per cent. sucrose in juice	0.31

CONCLUSIONS.

The results of this experiment are in close agreement with those of the one at Lower Estate presented above, and the conclusions are materially the same.

The small difference in tonnage in favour of the closer planted plots is not statistically significant. The number of sound canes was again significantly greater in the closer spacing, but the rotting was also more severe here.

Per cent. sucrose in juice was, in this experiment, significantly higher in the wider spacing.

The general conclusion from the first ratoon experiments is that, under the conditions obtaining in the growing season 1934–36, there was little difference between the two spacing distances 5′ x 2½′ and 5′ x 5′.

Further spacing experiments are being conducted co-operatively, and will be reaped during the crop of 1937.